

upon the skilful and intelligent conduct of the captain must necessarily depend in a great degree the safety and success of the vessel during her career. In order that the best results may be obtained in face of the difficulties incidental to the design and management of many modern types of ships, the standard of knowledge must be raised in all three classes.

W. H. WHITE

### THE "ENCYCLOPÆDIA BRITANNICA"

*Encyclopædia Britannica*. Ninth Edition. Vol. xv. Loo-Mem. Vol. xvi. Men-Mos. (Edinburgh: A. and C. Black, 1883.)

AMONG the most important scientific articles in vol. xv. of the new edition of the "Britannica" are those on Medicine, Mechanics, and Mammalia.

The concise but comprehensive epitome of the history of medicine which Dr. Payne has contributed is the only history of the kind in the language. In Germany there are in this subject, as in almost every other branch of learning, excellent text-books; and the author acknowledges his obligations to Häser's "Lehrbuch der Geschichte der Medicin und der epidemischen Krankheiten." In France, Daremberg's "Histoire des Sciences Médicales" is also well known. But in England there has been no serious attempt to write a history of medicine since the publication of Freind's letters to Mead (1725); even these only dealt with a portion of the subject, and were written or at least begun under the disadvantage of confinement in the Tower. There have been a few valuable contributions to the subject, such as Dr. Greenhill's articles in Smith's "Dictionary of Classical Biography," and Dr. Munk's Roll of the College of Physicians, but nothing more.<sup>1</sup>

Is this neglect justifiable? In other branches of natural history and natural philosophy an acquaintance with the successive steps by which modern knowledge has been won is almost necessary for clearly comprehending the result. A history of astronomy, of electricity, or of physiology would be not only of interest but of practical value to the student of each of these subjects. But a history of medicine, however important as a chapter in the development of human intellect and the progress of civilisation, is scarcely any help towards understanding either the principles or the practice of the art of healing. A modern physician finds some knowledge of chemistry and of physics indispensable; botany and zoology are not without important bearing on his professional studies; a knowledge of German is of great practical use; but he may be ignorant of all medical literature above fifty years old without any loss, except the loss of the intellectual pleasure which every educated man should take in the past history of his profession.

That this is the case seems evident from the utter neglect of the older medical classics in medical education, notwithstanding occasional murmurs from the few who have earned the right to murmur by having read them, and from others—a neglect which exists not only in practi-

cal England and America, but no less in the learned German and the conservative French schools. This neglect is only confirmed by occasional glimpses of the said classics, and it is illustrated by the fact that we owe even the sketch of the labours of two thousand years which forms the subject of this review to the demands of an encyclopædia.

Nor is the reason far to seek. Modern medicine has scarcely anything but its aim in common with the art of the ancients. The attempt of the older physicians was to find some comprehensive explanation which would account for all the diseases of mankind, and their practical method was the application of certain remedies, recommended by the crudest experience, or more often by some such dogmatic criterion as that of "signatures." The authority of the ancients was regarded as independent of proof. In like manner naturalists used to study the worthless gossip of Pliny, and Milton recommended Columella as a school-book because of the practical importance of husbandry; indeed in England we still teach geometry from an ancient Greek text-book, and Euclid will be the last to follow Aristotle and Galen, Dioscorides and Celsus, into learned oblivion. But the object of modern medicine is not to explain but to investigate, to ascertain what is amiss, and to deal with it as directly as possible, on the principles of physics and of chemistry, guided by experiment and checked by skilled statistics. Homœopathy is only the last of the "systems" of medicine; not more arbitrary than many others, and, like the rest, not so much a wrong solution of a scientific problem as an answer to a question which cannot reasonably be put.

The art of rational medicine must therefore depend upon a knowledge of the body and its functions, on the power of discovering its physical conditions, and on acquaintance with the physico-chemical laws to which it is subject; just as the art of navigation depends on a knowledge of astronomy and of meteorology. But even the rough outlines of anatomy were only made out during the sixteenth and seventeenth centuries, and the discovery of its minuter details, so well begun between 1650 and 1700, was only resumed and carried to its present degree of completion by the achromatic microscopes of the last fifty years. Morbid anatomy dates from Morgagni. Physiology had no true existence before Harvey's discovery of the muscular contraction of the heart and the circulation of the blood in 1628. It was retarded rather than helped by premature application of mechanical laws, and did not make important progress again until the birth of chemistry in the last thirty years of the eighteenth century. If anatomy may be dated from the dissections of Vesalius, physiology from the vivisections of Harvey, and chemistry from the laboratory of Lavoisier, we cannot fix the beginning of modern medicine earlier than the introduction of mediate auscultation by Laennec in 1819.

Interest, however, will always belong to the history of medicine, apart from the practical value of the older medical literature. The study of the dreary succession of the Greek "sects," of the Galenical and Arabian "schools," and of the subsequent iatro-chemical, iatro-mechanical, Brunonian, and other "systems," is of service to warn too eager speculation from the errors of

<sup>1</sup> Dr. Edward Meryon's "History of Medicine" was never finished. Dr. Adams's editions of Hippocrates and of Paulus Ægineta, Croke's of the "Regimen Sanitatis Salernitanum," and Payne's of Linacre's translation, "De Temperamentis," are scholarly works. "Lives of British Physicians" and "The Gold-headed Cane" are not ungracefully written. "The History and Heroes of the Art of Medicine" is a very poor compilation. A brilliant essay on the subject will be found at the end of "Poems" and other remains of the late Dr. Frank Smith (Smith and Elder, 1879).

past ages. Here and there, "apparent rari, nantes in gurgite vasto," records of real observation: the aphorisms of Hippocrates, or the clinical pictures of Sydenham. Occasionally a good style commends an almost valueless treatise, as in the case of Celsus and Fracastori. More often we are attracted by some amusing gossip, some shrewd remark, or some interesting historical allusion, to epidemics or to wars, to the deaths of kings and conquerors, or to the daily accidents of contemporary life. Such are Caius's account of the sweating sickness, Ambrose Paré's description of his treatment of gunshot wounds in Savoy and at Rouen, and the "cases" recorded by Dutch surgeons of the seventeenth century. Nay, apart from utility and from such chance rewards as these, there will always be those who take the genuine delight of a book-worm in old authors because they are old, those who have the respectable appetite for information which is omnivorous, and students of the human mind for whom acquaintance with its dullest wanderings is fruitful.

It is therefore well that English readers should have at least an outline of medicine in the past, and this want has been admirably supplied by Dr. Payne. Wisely abandoning all endeavours to include the biographical part of his subject, tempting as the excursion must often have seemed, and leaving on one side the curious history of medicine as a profession, its connection with the Church, the differentiation of its several branches, its varied social position, and the growth and decay of the great colleges and schools of medicine, he has aimed only at presenting within the narrow limits allowed (about thirty-seven columns quarto) a view of the changes of medical theories, and of the slow progress and frequent retrogression of the medical art. Beginning with an appreciative sketch of Hippocratic medicine, the important work of the Alexandrine physicians is next indicated, the scientific scope and character of Galen is described, and the obscure line of tradition of classical medicine is traced down to the mediæval school of Salerno. The vast, but thankless and little explored, field of Arabian medicine is then rapidly surveyed, and its dominion in Western Europe explained as being really little more than that of a corrupt Galenism. The revival of learning at the beginning of the sixteenth century was probably a misfortune to medicine, for when the Italian scholars, and our own Linacre and Caius translated the works of Galen into good Latin, these medical "classics" shared in the glory which surrounded the language of the New Testament and of Plato. The first steps of anatomy were in contradiction of statements by Galen, the first discovery of physiology was a refutation of his whole system. Yet the baneful influence of his great name, like that of the still greater name of Aristotle, lasted long after his claim to implicit credence had been disproved. As the ancient system was worn away, its place was eagerly striven for by the feeble systems of Paracelsus, Van Helmont, Borelli, Sylvius, Stahl, Hoffmann, John Brown, and Hahnemann in a long succession of three hundred years.

With the morbid anatomy of Morgagni, Baillie, and Laennec, and the physical diagnosis introduced by the latter great physician, the modern era of rational medicine began, in which sects and systems are mere survivals—superstitions—of an unduly prolonged middle age. At

this point Dr. Payne's heart and paper seem to fail together. He ends, much as Gray's bard ended his prophetic outline of English history, in a fine confused view of a period of light and splendour, illustrated by the names of Rokitsky and Virchow, Czermak and Helmholtz, Bright, Graves, Addison, Stokes, and Trousseau. It was no doubt wise not to attempt an account of the triumphs of the new era, but we hope that the learned author of this article may make it the foundation of a complete history of medicine, fuller and more exact than Daremberg's, lighter and brighter than those of Sprengel and Häser. We also venture to suggest to the editor of the "Encyclopædia Britannica" that an article dealing with the curious and interesting history of medicine as a profession should be obtained from the same pen, under the heading, say, of "Physic, History of the Practitioners of."

We have scarcely left room for finding fault, and little room is needed. But to redeem our encomium from the charge of blindness, we may ask why the history of the school of Salerno is given after that of Arabian medicine; what evidence there is apart from his name that Bernard Gordon of Montpellier (1307) was a Scot; and what possible aptitude there is in a comparison between two such different persons as the impudent, drunken vagabond who called himself Paracelsus and the great German reformer who lived at the same time.

Lastly, while we fully admit the justice of connecting the introduction of auscultation and of chemical and microscopical examination of morbid fluids with the introduction of a knowledge of morbid anatomy—for this connection was, in fact, the *novum organum* of medicine from 1820 onwards—yet we think that there should also have been indicated, however briefly, the still newer method which has characterised the history of yet more recent medicine, namely, the method of number and measurement, by which to the stethoscope and the test tube have been added the clinical thermometer, the compte-globule and the sphygmograph. Perhaps future historians of medicine (particularly if they should write "primers" or "outlines" "for examination purposes") will divide the nineteenth century into four periods: the first (1800-1820) introductory, the second (1820-1850) the period of morbid anatomy and of physical diagnosis, the third (1850-1880) the period of morbid histology and of quantitative investigation; while the last, we may hope, will be called the period of experimental medicine, in which laboratories shall do the same service for pathology and therapeutics which they have already done for physiology.

There appears, under the head of "Mechanics," another of those mathematical dissertations which, each complete in itself, are to be found at such frequent intervals in the volumes of the new edition of the "Britannica." The author of the part of this article which treats of theoretical mechanics is Prof. Tait, and those who are familiar with his writings will be able to form an estimate of the way in which the treatment of the subject is conceived and carried out.

The science of mechanics in its widest range rests on Newton's Three Laws of Motion, and on that other passage in the "Principia" dealing with the activity of an

agent, the full significance of which, when interpreted by the light of modern discoveries, was first made clear by Professors Thomson and Tait. An examination of Newton's original statement shows that in his view "equilibrium is not a balancing of forces, but a balancing of the effects of forces. When a mass rests on a table, gravity produces in it a vertically downward velocity which is continually neutralised by the equal upward velocity produced by the reaction of the table, and these forces . . . are equal because they produce in equal times equal and opposite quantities of motion."

As regards our knowledge of force as distinguished from its mechanical measure as change of momentum, we are reminded that our idea of force, originally derived from the muscular sense, "may be a mere suggestion of sense corresponding (no doubt) to some process going on outside us, but quite as different from the sensation which suggests it, as is a periodic shearing of the ether from brightness, or a periodic change of density of air from noise."

In discussing still further the nature of force, Prof. Tait points out that our belief in matter, the most certain of all objective realities, is largely based on the property of the unchangeability of its aggregate amount. "The only other thing in the universe which is conserved as matter is conserved is energy. Hence we conclude that energy is the true physical reality, and force, which is merely the space-rate at which energy is transformed, must be regarded like other expressions, such as rate of interest, death-rate, gradient of heat, as an expression introduced for convenience, and not necessarily because of an objective reality attached to it."

Remembering the dual nature of all force as being exerted between two bodies, we have, as another reading of the Third Law, "Every action between two bodies is a stress."

With regard to potential energy, which must depend in some hitherto unexplained way, like kinetic energy, on motion, Prof. Tait says: "The conclusion which appears inevitable is that, whatever matter may be, the other physical reality in the universe which is never found unassociated with matter, depends, in all its widely varied forms, upon motion of matter."

After explaining Newton's Laws, the author deals with the principles of kinematics, and then with statics and kinematics of various material systems, with different degrees of freedom, inserting amongst the analytical proofs several of those elegant geometrical constructions for which he is so well known. Whilst the nature of the article precludes a thorough exposition of the higher and more involved parts of the subject, he has succeeded in presenting illustrative problems of all the great divisions in mechanics, which afford some insight into the nature of the special parts of the subject to which they refer.

This most useful article, which exhibits the state of knowledge in theoretical mechanics at the present time, concludes with a list of the principal works on mechanics.

Following Prof. Tait's article, and under the heading of "Applied Mechanics," we have the reprint of an article by the late Prof. Rankine, contributed by him to the volume of the "Encyclopædia Britannica" which was published in 1857.

In this article Prof. Rankine has dealt with the principles of the subject very much on the same lines as in his larger published work on "Applied Mechanics." It is needless to say that nothing that Rankine wrote on the theory of mechanics can ever become antiquated or obsolete. He possessed such a firm grasp of the foundations of the subject, that it seems impossible to believe that on these points he could commit an error. But since that time many new discoveries have been made in mechanics, as in other sciences, to which we find no reference in the present articles. Of these perhaps the most important are the later developments of graphical statics, and the kinematical analysis of Prof. Reuleaux. The former subject, which really dates its origin from the time of the discoveries by Rankine of the Theory of the Extension of the Funicular Polygon, and by Clerk Maxwell of the Theory of Reciprocal Figures, has received at the hands of Culmann and others developments which are now proving themselves of the greatest importance in engineering design. Of the higher parts of these more modern methods no information is given, either in the article before us, or in the extremely clear and simple theory of Frames, which appears in Prof. Jenkin's article on "Bridges," in the fourth volume of this "Encyclopædia," or in any other place in the work, and having regard to the importance of the subject, we cannot but regret its absence.

We believe that had the work of Reuleaux been published earlier, Rankine would have been one of the first to recognise its beauty and value.

The whole article displays the power of logical arrangement and method, as well as the condensed style which is so characteristic of all Rankine's writings, and makes them such difficult reading for beginners. These will probably prefer his "Applied Mechanics," for purposes of study, to the article before us. But as an exposition, in small compass, of the leading principles of that science, it is altogether admirable as far as it goes, whilst its value is increased by the numerous articles in this "Encyclopædia" on special, more technical parts of the subject, such as that of Prof. Jenkin, already quoted, and that of Prof. Unwin on "Hydraulics," and others which are promised in forthcoming volumes.

The article on "Mammalia," by Prof. Flower, is an extremely well condensed and intelligibly written essay on the highest class of vertebrate beings, for which, as the author notes, there has never been a generally accepted vernacular designation. Still the class known to zoologists as Mammals is one rigidly defined, and one that obeys the strictest rules of logic in its definition, despite Kant's remarks on the impossibility of defining strictly natural objects. It is easy to imagine the mammary glands reduced to a state of extreme simplicity, but among living mammals this never occurs, nor is there any gland to be confounded with them in any other vertebrate form. The article opens with a chapter on the general anatomical characters of the class, in which an immense amount of accurate information is compressed into a small space. Many of the figures illustrating the details of the osteology are taken from Prof. Flower's well-known work on this subject. In the chapter on classification, the recent arguments of Prof. Huxley in favour of passing over all known

forms of birds and reptiles and going straight to the amphibia for the progenitors of the mammalia are quoted with approval; and that author's subdivision of the class into three sub-branches—Prototheria, Metatheria, and Eutheria—is adopted. The history of the distribution of the mammals in time and space follows; and then we have the characters of the different orders and families, and of the principal forms of the class. In this section of the memoir the illustrations, taken from the best sources, are especially to be praised, and in many instances the information as to rare or new species is brought well up to date. This seems to us especially so in the interesting group of the bats and insectivora, for which Prof. Flower acknowledges his indebtedness to Dr. G. E. Dobson, but in the portion devoted to the order Primates, an order which Prof. Flower makes to include the lemurs, the monkeys, and man, we read the little that is written under the impression that it was but introductory to a good deal that was to follow, and when we turned over to p. 446 we found the essay was finished and that we had arrived at the index; even this bears marks of a forced compression, for while the earlier letters are fairly done, the last in the index have evidently had a lot "squeezed" out.

One other article relating to zoology in this volume is also by Prof. W. H. Flower, on the "Mammoth." He alludes to the derivation of this name as being by some ascribed to a Tartar origin, by others that it is a corruption of the Arabic word *Behemoth*, or great beast, but on the authority of Prof. Sayce it is a corruption of the Biblical *Behemoth*, Arabic *behimat*.

The scientific articles in vol. xvi. are so numerous and important that it is impossible for us to give them satisfactory notice in the space at our disposal; we can do no more than name the more important. From Prof. Dittmar we have Metallurgy and Metals; Prof. Chandler Roberts and Mr. R. A. Hill contribute the article on Mint, in which all aspects of the subject are fully as well as interestingly treated; while Mining, by Dr. Le Neve Foster, is both practical and scientific. Meteorology, of course, has been undertaken by Mr. Buchan and Prof. Balfour Stewart, and forms an admirable exposition of the present condition of a science of great and growing complexity; Mr. Buchan treating of instruments and phenomena, while Prof. Stewart deals with the science that underlies the subject. The article on Micrometer is by Dr. David Gill; while it is natural to find Dr. W. B. Carpenter's name attached to that on Microscope. Prof. Heddle contributes an elaborate and profusely illustrated article on Mineralogy. Molecule has a triple authorship, Rev. H. W. Watson, Mr. S. H. Burbury, and Prof. Crum Brown, both its physical and chemical aspects being thus fully treated. The article on Mollusca in this volume, by Prof. Ray Lankester, is as complete and masterly and richly illustrated as that on Mammalia in the previous volume. Under Moon we have a short article on the lunar theory, by Prof. Simon Newcomb; other aspects of the subject have been dealt with under Astronomy. Mr. P. Geddes has a careful and wonderfully exhaustive article on Morphology; and Mr. R. M'Lachlan finishes off the volume with a somewhat tiny article on Mosquito. There are many other smaller articles in all

departments of science,—Prof. A. Newton, for example, doing all birds,—and several important ethnologico-geographical articles, as Mexico, by Mr. E. B. Tylor and Prof. Keane, and Mongols, by Prof. Douglas and Prof. Jülg. We hope in a future number to be able to refer in detail to some of the articles mentioned.

### LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.]

[The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.]

#### Living Scorpions, Mygale, and Protopteris

WILL you allow me to use your columns in order to ask any of your readers residing in tropical localities, who may be generous enough to wish to help a naturalist in his researches, to send to me *living* specimens of large Scorpions (not less than three inches in length), and *living* specimens of large Mygale (birds-nesting spider); also I would beg for *living* Earthworms of large size from African, Indian, American, and Australian localities. Any of these animals can be sent in a small tin box in which a few holes are perforated; the tin box being packed in a much larger wooden box with hay or loose paper. Damp moss should be placed with the Scorpion or Mygale. Each specimen should be inclosed in a separate tin box, since these animals are cannibals. The holes in the tin box containing an Earthworm should be very few, and the amount of damp moss very great. Earthworms would travel best in a Wardian case, should the opportunity offer—not loose, but in the above-mentioned tin box.

I would further take this opportunity to ask for information concerning the best way of keeping the African Lepido-iren, or mud-fish (*Protopteris annectens*), in confinement. I require to ascertain (1) its natural food, (2) the temperature of the waters in which it naturally lives, (3) whether these are stagnant or rapidly running, (4) whether anything is known as to habits in the breeding season, and if this season immediately precedes or succeeds the dry season.

Some of your readers in this country or in Africa may have gained experience on these points, and would greatly help me in an attempt to breed the mud-fish by communicating with me.

E. RAY LANKESTER

11, Wellington Mansions, North Bank, N.W.

#### Electricity in India.—The Green Sun

[THE following letter has been sent us for publication by Sir William Thomson, to whom it is addressed:—]

For nearly a month the air has been in a state of electrification, which seems to me so interesting that I thought you would probably like to hear of it at once without my waiting to complete my observations. Unfortunately I cannot tell the exact date at which it began, but August 31 showed positive electricity all day apparently. On September 1 and 2, I was not able to get any measurements, but on the 3rd at 1.10 p.m., I got negative readings from -28 to -17 div., wind light, S. by W. By 2.45 it had changed to +6. Next morning at 10.5 a.m. it varied from -136 to -44; this was on the roof. I then took it to the ground, to a place quite open, and found readings from -460 in gusts of wind to -162 when the wind was light. The wind was fresh, westerly. Up to 1h. 14m. it continued negative, but at my next reading, 3 p.m., it was +35, and remained steadily positive, the wind having now gone round to the east (sea breeze).

5th, 6 a.m., positive, from 9 a.m. to 2.5 negative, and thereafter positive.

This continued with the exception of the 9th, when it was positive all day till the 13th.

On the 20th the reading at 9.55 was -34, but at 11.55 it was +44, the wind in the meanwhile having changed from west (land wind) to east (sea breeze). A similar state of affairs still continues.

During all this time the weather in Madras has been fine, and